

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of	)	
	)	Examiner: <b>Ivars C. Cintins</b>
<b>Mark Hernandez</b>	)	
	)	Art Unit: <b>1724</b>
Serial No: <b>10/627,947</b>	)	
	)	Attorney Docket: <b>MJ-1</b>
Filed: <b>July 25, 2003</b>	)	
	)	Date: <b>May 11, 2007</b>
For: <b>REMOVING METALS FROM SOLUTION</b>	)	
<b>USING METAL BINDING COMPOUNDS</b>	)	
<u><b>AND SORBENTS THEREFOR</b></u>	)	

**REPLY BRIEF**

Mail Stop Appeal Brief - Patents  
 Commissioner of Patents  
 P. O. Box 1450  
 Alexandria, VA 22313

Dear Sir:

Applicants submit this Reply Brief to the Board of Patent Appeals and Interferences on appeal from the decision of the Examiner of Group Art Unit 1724 dated January 25, 2006. Please charge any additional fees that may be required to make this Reply Brief timely and acceptable to Deposit Account no. 19-1685 (Order # **MJ-1**).

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### **STATUS OF THE CLAIMS**

Claims 1-22, 24, 25, 26 and 28-35 stand pending in the present application. Claims 1-22, 24, 25 and 28-35 were originally presented. Claims 5, 8, 11 and 23 were amended in response to the first Office Action. Claims 1, 26, 28, 30, 33 and 34 were amended in response to the second Office Action. Claim 26 has been allowed.

## **GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

The grounds of rejection to be reviewed on appeal are:

1. Claims 1-22, 24, 25 and 28-35 stand rejected under 35 U.S.C. 103 (a) as being unpatentable over a doctoral thesis entitled FATE AND TOXICITY OF AIRCRAFT DEICING FLUID ADDITIVES THROUGH ANAEROBIC DIGESTION by Cynthia Lee Gruden as directed by Dr. Mark Hernandez (hereinafter, Gruden) in view of another publication entitled METAL ADSORPTION BY ACTIVATED CARBON: EFFECT OF COMPLEXING LIGANDS, COMPETING ADSORBATES, IONIC STRENGTH, AND BACKGROUND ELECTROLYTE by Reed, et al. (hereinafter Reed).

2. Claim 34 additionally stands rejected under 35 U.S.C. § 103 (a) as being unpatentable over an EPA publication entitled INVESTIGATION OF SELECTED POTENTIAL ENVIRONMENTAL CONTAMINANTS: BENZOTRIAZOLES (hereinafter, the EPA publication).

## ARGUMENT

### **I. Gruden in view of Reed does not render obvious claims 1-22, 24, 25 and 28-35.**

Claims 1-22, 24, 25 and 28-35 were rejected under 35 U.S.C. § 103(a) as being unpatentable over a doctoral thesis entitled FATE AND TOXICITY OF AIRCRAFT DEICING FLUID ADDITIVES THROUGH ANAEROBIC DIGESTION by Cynthia Lee Gruden as directed by Dr. Mark Hernandez (hereinafter, Gruden) in view of another publication entitled METAL ADSORPTION BY ACTIVATED CARBON: EFFECT OF COMPLEXING LIGANDS, COMPETING ADSORBATES, IONIC STRENGTH, AND BACKGROUND ELECTROLYTE by Reed, et al. (hereinafter Reed).

In response to Appellants' arguments with respect to Gruden, the Examiner, in the Response to Argument in Examiner's Answer of March 13, 2006, asserts that no mention is made in Gruden that MeBT sorbs to GAC while simultaneously binding heavy metals only in the presence of a biomass. The Examiner then asserts that one having ordinary skill would have been motivated to treat any known heavy metal contaminated solution, acidic or otherwise, by this technique. Appellants respectfully disagree. Initially, it is again noted that this appears to be a construction of Gruden which takes an isolated teaching out of context with limited deference to what the reference teaches when viewed as a whole, as will be discussed immediately hereinafter.

The Gruden thesis, as a whole, is focused on the fate of storm runoff containing aircraft deicing fluid through a common biological sewage treatment process, as conventional anaerobic digestion. As described by Gruden, activated carbon was added to anaerobic digesters to help mitigate the toxicity associated with one of the deicing fluid components called Methylbenzotriazole (MeBT). The single sentence, to which the examiner isolatedly refers in the Gruden thesis, is clearly in the context of this specific type of anaerobic biological wastewater treatment process accepting mixtures of industrial wastewater and domestic sewage. Gruden's closing comment reads:

Current novel digester configurations (USAB) have incorporated GAC as a support matrix to retain high biomass levels. Results from this research indicate that the addition of GAC to an anaerobic treatment system for ADF waste may diminish the toxic effects of MeBT and may eliminate MeBT from the effluent. This design may be fortuitous for other industrial waste streams because MeBT sorbs to GAC while simultaneously binding heavy metals; thus, adding MeBT to PACT or USAB may enable the treatment of waste streams with very high metals content that would otherwise be toxic.

These observations merely hypothetically extend the subject matter of the thesis to two other common variations of conventional biological wastewater treatment processes called PACT (powdered activated

carbon treatment) and USAB (upflow sludge anaerobic blanket) which explicitly include activated carbon as part of their designs, and which must operate with sensitive bacterial consortia at near neutral pH. Where the Gruden thesis states “thus, adding MeBT to PACT or USAB may enable the treatment of waste streams with very high metals content that would otherwise be toxic,” the thesis is referring to the same unintended mode of MeBT addition to PACT or USAB processes, as was observed as the primary subject matter of the thesis with respect to a common biological sewage treatment process that is presented with deicing runoff containing MeBT. The fortuitous result of which would likewise be avoiding toxicity of some metals (and there often are metals in airport runoff) as well as any MeBT present in this type of runoff. Because PACT and USAB digesters are biologically based anaerobic treatment systems, i.e. also representing conventional biological wastewater treatment processes, these processes implicitly cannot treat inorganic industrial wastewaters without taking substantial precautions, none of which are mentioned by Gruden. Further, all of these conventional wastewater treatment processes are notoriously sensitive to heavy metals: this implicit context is common to the wastewater treatment field and it is in this context which Gruden makes this closing statement. Gruden was not referring to any sort of purposeful, engineered, pre-immobilization of MeBT or other benzotriazoles on GAC, in abiotic systems, for treating only metal-laden industrial wastewaters at depressed pH – which underlies independent claims 1, 28, 30 and 33. Accordingly, it is believed that the Examiner's assertion that Gruden teaches the treatment of any known heavy metal contaminated solution, acidic or otherwise, sweeps far too broadly.

Further, Appellant believes that one of ordinary skill in the art would clearly recognize the intent of this paragraph as extending the teachings from one common form of anaerobic digestion process to two other common forms of anaerobic digestion processes, rather than attempting to teach some sort of a universal process that would even apply to acidic streams. Certainly, if that were the case, it is submitted that Gruden would have presented, in the main body and subject matter of the thesis, some manner in which the biomass of a conventional sewage treatment process could be protected from an acidic waste stream. In this regard, the entire focus of the Gruden thesis is pointless if the biomass is destroyed. Given that this teaching is missing with respect to the fundamental subject matter of the Gruden thesis, it is clearly unreasonable to suddenly extend the teachings of the Gruden thesis, based on the mere mention of alternative common anaerobic digesters, in an unrelated direction which is completely inconsistent with fundamental subject matter of the thesis. The mechanism of MeBT addition in the Gruden thesis, relates to the capricious sorption of MeBT from wastewater after the MeBT enters a pH sensitive biological system. Claims 1, 28, 30 and 33, on the other hand, implement a designed immobilization of benzotriazoles on GAC for the express purpose of metal coordination in acidic environments that prohibit biological treatment. It is clear that the relied on passage in Gruden is being mischaracterized and taken in isolation from the rest of the passage as having an all-encompassing scope, in order to apply to any industrial waste stream, even one that is acidic and which would render the Gruden digester inoperable for its intended purpose, since the acidity will kill the biomass that

provides the very functionality of the digester. For at least this reason, one of ordinary skill in the art would not only have no motivation have no motivation to modify Gruden as suggested to operate on an acidic waste stream, but would recognize that the subject digesters would be rendered inoperable for their intended purpose. This is especially the case since Gruden itself fails to teach, disclose or reasonably suggest any modification which would allow an anaerobic digester of any type to accept an acidic waste stream without killing the biomass of the digester. Accordingly, it is respectfully requested that the Board deem these arguments as persuasive. Further, Reed does not cure the deficiencies of Gruden, as will be discussed immediately hereinafter.

In response to Appellants' arguments with respect to Reed, the Examiner, in the Response to Argument in Examiner's Answer asserts that Reed provides a motivation to treat an acidic solution in the manner proposed with respect to Gruden. As described above, Gruden describes the removal of methylbenzotriazole from aircraft deicing fluid. There is no discussion, or experimental observation, in Gruden with respect to an acidic environment nor is there a teaching in Gruden with respect to the presence of any metal contamination in this run-off. Reed, on the other hand, teaches removal of metal contamination in an acidic environment using electrostatic charge with EDTA and a unique carbon that maintains a positive charge at negative pH. The Examiner deems that whether Reed understands the mechanism at play in Gruden is irrelevant. Appellants respectfully disagree. These are not minor differences, but are believed to be major obstacles in the face of one having ordinary skill in the art. The Gruden environment is defined by anaerobic microbiological activity and is expressly not acidic for this reason, and there is absolutely no suggestion in Gruden of an acidic environment. With this in mind, it is impossible to modify the Gruden reference to process an acidic waste stream, since the digester will be completely inoperable for its intended purpose. Reed, on the other hand, teaches the use of EDTA to remove metal contaminants in an entirely different and clearly distinguishable approach as compared to Gruden and compared to the approach taken by Appellants, namely the use of an amphipathic, heterocyclic metal coordinating compound as recited by independent claims 1, 28, 30 and 33. Appellants believe that it is improper to ignore what Reed teaches as a whole, when it is entirely inconsistent with the approach that is taken by Gruden. This impropriety is further exacerbated by the fact that Reed explicitly disavows any understanding of any mechanism other than electrostatic immobilization. This disavowal clearly encompasses the subject matter of Gruden. Accordingly, Appellants respectfully believe that one of ordinary skill in the art would immediately reject Reed as having any relevance to Gruden. For at least these reasons, Appellants respectfully submit that the Board should deem the arguments bearing on the irrelevance of Reed as persuasive and overturn the rejections of claims 1, 28, 30 and 33.

Applicants respectfully point out that Reed stands sound on its conclusion, which is narrow regardless of pH. While Reed does address the combination of a metal and a complexing agent for the removal of heavy metals in an acidic pH stream, the type of complexing agent(s), and their mechanism of interaction with

metals and activated carbon surfaces (both H and L) is considered to be completely different. The assertions that have been made by the Examiner operate to improperly generalize the key mechanisms underlying engineerable metal retention of polyacetate-metal-activated carbon systems, to that of benzotriazole-metal-activated carbon systems.

Indeed, Reed's conclusion was clear and unambiguous in stating that electrostatic (ionic) interactions are responsible for the attraction of common chelating agents (e.g., aminated polyacetates) to activated carbon; whereas the present Application shows that hydrophobic interactions (i.e. absorption + adsorption) are the main interactions driving the binding of benzotriazole derivatives to activated carbon. The governing (surficial) retention mechanisms of the respective chelating agents — ionic interactions (in Reed) v. charge neutral sorptive interactions (per claims 1, 28, 30 and 33) — are so fundamentally different that it is clearly not generalizable in terms of obviousness. The difference between these mechanisms is witnessed, for example, by the fact that common aqueous interferences, such as water hardness, affect the common polyacetates like EDTA, and benzotriazoles very differently. Hardness constituents like calcium and magnesium have negligible effect on benzotriazole immobilization systems, where the hardness constituents have measurable interactions with EDTA and its analogues.

In the case of EDTA-metal complexes with Ni and Cd down to pH 3, Reed at page 1996, lns. 2-8 suggests that the enhancement of metal removal is due to the fact that the EDTA-Metal complex is negatively charged, and the carbon, in this case Calgon F400, is positively charged. Claims 1, 28, 30 and 33 are not based on electrostatic mechanisms, but rather on a sorbent in combination with an uncharged metal-benzotriazole complex. That is, the sorbent is surface tends to relative neutrality in acidic pH ranges.

Appellants' Benzotriazole-metal-activated carbon systems have been optimized using both H and L activated carbon(s), the behavior of which is clearly consistent with sorptive interactions, and, unlike Reed's studies, Appellants have clearly shown that benzotriazoles are uncharged in the acidic range between about 1.5 to 4.5 – depending on the particular derivative. Thus, the nature of their interactions with the activated carbons tested are non-ionic, and sorptive in their behavior. Reed teaches that aminated polyacetates have ionic behavior, which drives their interactions with activated carbon, particularly at low pH. The physical chemistry of ionic electrostatic interactions, and hydrophobic/hydrophilic sorptive interactions, as between these chelating and metal coordinating agents are fundamentally and profoundly different. It is these differences in these very different surface chemical interactions that are exploited by claims 1, 28, 30 and 33.

Appellants have presented arguments for the separate patentability of claims 3, 5, 7-10, 15, 16 and 18. With regard to these arguments, the Examiner asserts that these arguments should be deemed as unpersuasive based on the mere absence in Appellants' Appeal Brief of a sub-heading, when this sub-heading is not mandatory. In this regard, the Appeal Brief clearly asserts that these claims are separately patentable beyond



the limitations of claim 1, from which they depend. Further, Appellants' Appeal Brief clearly asserted that the claims of Group I, including claims 1-22, do not stand or fall together. Accordingly, it is respectfully requested that the separate patentability of claims 3, 5, 7-13, 15, 16 and 18 should be considered by the Board at least for the reasons given below.

### **Claim 3**

Claim 3 recites that the metal-coordinating compound includes a binding portion containing a plurality of heteroatoms and a hydrophobic portion for hydrophobically sorbing to the sorbent. It is noted that this claim is considered to clearly exclude the use of immobilization via electrostatic force. For at least this reason, it is respectfully requested that the Board overturn the rejection of Claim 3.

### **Claim 5**

Claim 5 recites that the specific pH is in a range from approximately pH 2 to pH 6 and the metal-coordinating compound is Benzotriazole, Benzothiazole or Methylbenzotriazole. It is of interest to note that the Reed reference shows no data below pH 3. In this regard, it is suspected that the electrostatic immobilization technique taught by Reed is inoperable at such depressed pH levels at least for the reason that the selected H type carbon and metal-chelating EDTA will experience a markedly lesser attraction as EDTA interacts with protons and the positively charged state of the activated carbon increases with continued pH depression. Hence, for at least these reasons, it is respectfully requested that the Board overturn the rejection of Claim 5.

### **Claims 7-10**

Claim 7 recites an extremely acidic environment in which the specific pH is less than approximately 2. Again, Reed shows no data below pH 3. With respect to the mechanism of Reed, EDTA cannot be not as efficient a heavy metal chelator as benzotriazole at depressed pH levels because of its acid-base and coordination properties. As pH drops, the chelating ability of EDTA for selected metals becomes markedly decreased as metal competes for the electronegative sites for coordination. The multi dentate coordinate structure of EDTA is compromised below pH 6.8, where only one half of its four carboxyl oxygen moieties are readily available for coordination. Below pH 3, EDTA has lost much of its electronegativity. Its multidentate binding characteristics are seriously diminished approaching pH 2.6

Simple benzotriazole derivatives, however, retain their metal coordinating ability to pH 2 and the electronegativity and metal coordinating properties are maintained until its lower pKa is quenched (2.0). Unlike EDTA, the phenyl moiety of benzotriazole makes metal-benzotriazole complex attractive to neutral

surfaces at low pH without conventional electrostatic (ionic) interactions. Accordingly, for at least these reasons, it is respectfully requested that the Board overturn the rejection of claim 7.

Claim 8 depends from Claim 7 and recites that the metal-coordinating compound is selected as at least one of carboxybenzotriazole, any fatty acid conjugated benzotriazole derivative, butylbenzotriazole, other aliphatic conjugated benzotriazole and benzothiazole. Claim 9 depends from Claim 7 and requires that the sorbent is an acidic activated carbon. Claim 10, likewise depends from Claim 7 and requires that the sorbent is an L type activated carbon. Reed specifically uses an H type activated carbon. Clearly, the art of record is devoid of any teaching with respect to operation below pH 2. Hence, for at least these reasons, it is respectfully requested that the Board overturn the rejections of Claims 8-10.

### **Claims 11-13**

Claim 11 depends from Claim 9 and recites that the metal-coordinating compound is at least one of benzotriazole and benzothiazole. Claim 12 depends from Claim 11 and further requires that the sorbent is an acidic activated carbon. Claim 13 also depends from Claim 11 and further requires that the sorbent is an L type activated carbon, as opposed to the use of an H type carbon in Reed. Again, the art of record is devoid of any teaching with respect to operation below pH 2 and particularly the use of these materials, as claimed, including L type activated carbon. Hence, for at least these reasons, it is respectfully requested that the Board overturn the rejections of Claims 11-13.

### **Claim 15**

Claim 15 recites equilibrating the sorbent and the metal-coordinating compound prior to enclosing. Applicants are unable to find any reasonably related teaching in the art of record. In the context of the rejections, the Examiner merely asserts that the use of an enclosure is obvious. While these limitations were raised in Applicants' response of August 24, 2005, Applicants find no specific rationale made by the Examiner in support of the rejection. Accordingly, it is respectfully submitted that a prima facie case of obviousness has not been made out. For at least these reasons, it is respectfully requested that the Board overturn the rejection of Claim 15.

### **Claim 16**

Claim 16 recites removing from the solution the metal-coordinating compound sorbed to the sorbent and the metal cations bound with the sorbed metal-coordinating compound. Applicants are unable to find any reasonable teaching with respect to these limitations in the art of record. While these limitations were raised in Applicants' response of August 24, 2005, Applicants find no specific rationale made by the Examiner in support of the rejection. Accordingly, it is respectfully submitted that a prima facie case of obviousness has

not been made out. For at least these reasons, it is respectfully requested that the Board overturn the rejection of Claim 16.

### **Claim 18**

Claim 18 requires that adding includes forming a combination of the metal-coordinating compound sorbed to the sorbent and, thereafter, introducing the combination into the solution. Applicants respectfully submit that the art of record is devoid of this feature in any reasonable combination. While these limitations were raised in Applicants' response of August 24, 2005, Applicants find no specific rationale made by the Examiner in support of the rejection. Accordingly, it is respectfully submitted that a prima facie case of obviousness has not been made out. For at least these reasons, it is respectfully requested that the Board overturn the rejection of Claim 18.

### **Claim 19**

Claim 19 requires that adding includes separately introducing each of the metal-coordinating compound and the sorbent to the solution. Claim 20 further requires that the metal-coordinating compound is introduced before the sorbent is introduced. Applicants respectfully submit that the art of record is devoid of any reasonable suggestion of these features in any reasonable combination. Further, Applicants are unable to find any discussion of these features in the rejections of the claims. Hence, for at least these reasons, it is respectfully requested that the Board overturn the rejection of Claim 19.

## **II. The EPA publication entitled INVESTIGATION OF SELECTED POTENTIAL ENVIRONMENTAL CONTAMINANTS: BENZOTRIAZOLES does not Anticipate Claim 34**

Claim 34 recites in a solution, having a specific acidic pH that is sufficiently acidic to liberate metal cations into solution so as to contaminate the solution with the metal cations, a method comprising binding at least some of the metal cations to an amphipathic, heterocyclic metal-coordinating compound, at said specific acidic pH, for subsequent use. With respect to these limitations, the Examiner has assertedly merely proposed treating wastewater having a slightly acidic pH in the Response to Arguments section of the Examiner's Answer, and refers to the penultimate paragraph on page 81 of the EPA publication. The latter, however, describes a process using a pH of 7.85 which is basic rather than slightly acidic. In this regard, suggestion of a "slightly acidic pH (e.g., 6.85)" is not supported by the EPA publication. Given a neutral pH of 7.0, the reference teaches a value that is 0.85 greater than neutral. Hence, it is respectfully considered as unreasonable to arbitrarily invoke a pH value that is 0.15 lower than neutral. Accordingly, the interpretation of the EPA publication is believed to be inconsistent with what it actually teaches. For at least these reasons, it is respectfully requested that the Board overturn the rejection of Claim 34.

Applicants believe that the rejection of claim 34 operates to inappropriately interpret pH effects of an immobilization system, as demonstrated by the statement that appears on page 5, Ins. 3-4 of the Examiner's Answer:

Furthermore mercury, copper and cadmium are soluble at this slightly acidic pH (6.85)...

With respect to heavy metal chemistry, it should be appreciated that the form of dissolved metal can markedly change as pH changes – that form (also known as “metal species”) has a governing effect on coordination/chelating behaviors and sorption potential. The metals, mercury, copper and cadmium (and, in fact, all transition metals) are completely different species in acidic, neutral and alkaline pH. This acidic metal speciation behavior, and the ensuing specific interactions in which these metals participate with benzotriazole derivatives, is not believed to be obvious, and it is respectfully believed that those having ordinary skill in the wastewater treatment art would not make unsupported pH behavior assumptions. Accordingly, for at least these reasons, it is respectfully requested that the Board overturn the rejection of Claim 34.

### **III. Additional Arguments were Presented in Favor of Group III**

The Examiner has asserted that Appellants have not presented any additional arguments in behalf of the patentability of this group. Appellants' Appeal Brief, however, did specifically raise the point that Appellants prior arguments with respect to claims 31 and 32 were not been addressed by the Examiner. Hence, it is submitted that a prima facie case has not been made with respect to these claims and Appellants are unable to respond to the rejections. Accordingly, it is respectfully submitted that at least Group III should be considered in conjunction with Group I. Further, it is respectfully requested that the Board overturn the rejections of claims 31 and 32.

### **Conclusion**

In conclusion, the Gruden and Reed references, relied on by the Examiner, alone or in combination, do not teach, show or suggest the decontamination mechanism that is recited by the claims. Moreover, the combination of Gruden and Reed is not reasonable. Based on the foregoing, Applicant respectfully requests that the Board overturn the Examiner's rejections of all pending claims, that have not yet been allowed, and hold that all of the claims of the present Application are allowable.

Dated: May 11, 2007

Respectfully submitted,  
/Michael M. Pritzkau/  
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